BALLANTINE
ROBERT A.
HEINLEIN
MISFIT

Misfit
BY ROBERT A HEINLEIN

Giants come in all sizes, ages, and disguises. And as mankind ventures into space on an ever greater scale, crucial challenges will appear from unexpected directions. And so will the giant intellects to solve them.

"… for the purpose of conserving and improving our interplanetary resources, and providing useful, healthful occupations for the youth of this planet."

Excerpt from the enabling act, H.R. 7118, setting up the Cosmic Construction Corps.

"Attention to muster!" The parade ground voice of a First Sergeant of Space Marines cut through the fog and drizzle of a nasty New Jersey morning. "As your names are called, answer 'Here', step forward with your baggage, and embark. Atkins I"

"Here!"

"Austin!"

"Hyar!"

"Ayres!"

"Here!"

One by one they fell out of ranks, shouldered the hundred and thirty pounds of personal possessions allowed them, and trudged up the gangway. They were young—none more than twenty-two—in some cases luggage outweighed the owner.

"Kaplan!"

"Here!"

"Keith!"

"Heah!"

"Libby!"

"Here!" A thin gangling blonde had detached himself from the line, hastily wiped his nose, and grabbed his belongings. He slung a fat canvas bag over his shoulder, steadied it, and lifted a suitcase with his free hand. He started for the companionway in an unsteady dog trot. As he stepped on the gangway his suitcase swung against his knees. He staggered against a short wiry form dressed in the powder-blue of the Space Navy. Strong fingers grasped his arm and checked his fall.

ˆSteady, son. Easy does it.“ Another hand readjusted the canvas bag.

On, excuse me, uh“—the embarrassed youngster automatically counted the four bands of silver braid below the shooting

star-”Captain. I didn’t-“

“Bear a hand and get aboard, son.”

“Yes, sir.”

The passage into the bowels of the transport was gloomy. When the lad’s eyes adjusted he saw a gunner’s mate wearing the brassard of a Master-at-Arms, who hooked a thumb towards an open air-tight door.

“In there. Find your locker and wait by it.” Libby hurried to obey. Inside he found a jumble of baggage and men in a wide low-ceilinged compartment. A line of glow-tubes ran around the junction of bulkhead and ceiling and trisected the overhead; the soft roar of blowers made a background to the voices of his shipmates. He picked his way through heaped luggage and located his locker, seven-ten, on the far wall outboard. He broke the seal on the combination lock, glanced at the combination, and opened it. The locker was very small, the middle of a tier of three. He considered what he should keep in it. A loudspeaker drowned out the surrounding voices and demanded his attention:

“Attention! Man all space details; first section. Raise ship in twelve minutes. Close air-tight doors. Stop blowers at minus two minutes. Special orders for passengers; place all gear on deck, and lie down on red signal light. Remain down until release is sounded. Masters-at-Arms check compliance.”

The gunner’s mate popped in, glanced around and immediately commenced supervising rearrangement of the baggage. Heavy items were lashed down. Locker doors were closed. By the time each boy had found a place on the deck and the Master-at-Arms had okayed the pad under his head, the glow-tubes turned red and the loudspeaker brayed out.

“All hands—Up Ship! Stand by for acceleration.” The Master-at-Arms hastily reclined against two cruise bags, and watched the room. The blowers sighed to a stop. There followed two minutes of dead silence. Libby felt his heart commence to pound. The two minutes stretched interminably. Then the deck quivered and a roar like escaping high-pressure steam beat at his ear drums. He was suddenly very heavy and a weight lay across his chest and heart. An indefinite time later the glow-tubes flashed white, and the announcer bellowed:

“Secure all getting underway details; regular watch, first section.” The blowers droned into life. The Master-at-Arms stood up, rubbed his buttocks and pounded his arms, then said:

“Okay, boys.” He stepped over and undogged the airtight door to the passageway. Libby got up and blundered into a bulkhead, nearly falling. His legs and arms had gone to sleep, besides which he felt alarmingly light, as if he had sloughed off at least half of his

inconsiderable mass.

For the next two hours he was too busy to think, or to be homesick. Suitcases, boxes, and bags had to be passed down into the lower hold and lashed against angular acceleration. He located and learned how to use a waterless water closet. He found his assigned bunk and learned that it was his only eight hours in twenty-four; two other boys had the use of it too. The three sections ate in three shifts, nine shifts in all—twenty-four youths and a master-at-arms at one long table which jam-filled a narrow compartment off the galley.

After lunch Libby restowed his locker. He was standing before it, gazing at a photograph which he intended to mount on the inside of the locker door, when a command filled the compartment:

"Attention!"

Standing inside the door was the Captain flanked by the Master-at-Arms. The Captain commenced to speak. "At rest, men. Sit down. McCoy, tell control to shift this compartment to smoke filter." The gunner's mate hurried to the communicator on the bulkhead and spoke into it in a low tone. Almost at once the hum of the blowers climbed a half-octave and stayed there. "Now light up if you like. I'm going to talk to you.

"You boys are headed out on the biggest thing so far in your lives. From now on you're men, with one of the hardest jobs ahead of you that men have ever tackled. What we have to do is part of a bigger scheme. You, and hundreds of thousands of others like you, are going out as pioneers to fix up the solar system so that human beings can make better use of it.

"Equally important, you are being given a chance to build yourselves into useful and happy citizens of the Federation. For one reason or another you weren't happily adjusted back on Earth. Some of you saw the jobs you were trained for abolished by new inventions. Some of you got into trouble from not knowing what to do with the modern leisure. In any case you were misfits. Maybe you were called bad boys and had a lot of black marks chalked up against you.

"But everyone of you starts even today. The only record you have in this ship is your name at the top of a blank sheet of paper. It's up to you what goes on that page.

"Now about our job—We didn't get one of the easy repair-and-recondition jobs on the Moon, with week-ends at Luna City, and all the comforts of home. Nor did we draw a high-gravity planet where a man can eat a full meal and expect to keep it down. Instead we've got to go out to Asteroid HS-5388 and turn it into Space Station E-M3. She has no atmosphere at all, and only about two per cent Earth-surface gravity. We've got to play human fly on her for at least six months, no girls to date, no television, no recreation that you don't devise

yourselves, and hard work every day. You'll get space sick, and so homesick you can taste it, and agoraphobia. If you aren't careful you'll get ray-burnt. Your stomach will act up, and you'll wish to God you'd never enrolled.

"But if you behave yourself, and listen to the advice of the old spacemen, you'll come out of it strong and healthy, with a little credit stored up in the bank, and a lot of knowledge and experience that you wouldn't get in forty years on Earth. You'll be men, and you'll know it.

"One last word. It will be pretty uncomfortable to those that aren't used to it. Just give the other fellow a little consideration, and you'll get along all right. If you have any complaint and can't get satisfaction any other way, come see me. Otherwise, that's all. Any questions?"

One of the boys put up his hand. "Captain?" he enquired timidly.

"Speak up, lad, and give your name."

"Rogers, sir. Will we be able to get letters from home?"

"Yes, but not very often. Maybe every month or so. The chaplain will carry mail, and any inspection and supply ships."

The ship's loudspeaker blatted out, "All hands! Free flight in ten minutes. Stand by to lose weight." The Master-at-Arms supervised the rigging of grab-lines. All loose gear was made fast, and little cellulose bags were issued to each man. Hardly was this done when Libby felt himself get light on his feet—a sensation exactly like that experienced when an express elevator makes a quick stop on an upward trip, except that the sensation continued and became more intense. At first it was a pleasant novelty, then it rapidly became distressing. The blood pounded in his ears, and his feet were clammy and cold. His saliva secreted at an abnormal rate. He tried to swallow, choked, and coughed. Then his stomach shuddered and contracted with a violent, painful, convulsive reflex and he was suddenly, disastrously nauseated. After the first excruciating spasm, he heard McCoy's voice shouting.

"Hey! Use your sick-kits like I told you. Don't let that stuff get in the blowers." Dimly Libby realized that the admonishment included him. He fumbled for his cellulose bag just as a second temblor shook him, but he managed to fit the bag over his mouth before the eruption occurred. When it subsided, he became aware that he was floating near the overhead and facing the door. The chief Master-at-Arms slithered in the door and spoke to McCoy.

"How are you making out?"

"Well enough. Some of the boys missed their kits."

"Okay. Mop it up. You can use the starboard lock." He swam out.

McCoy touched Libby's arm. "Here, Pinkie, start catching them

butterflies." He handed him a handful of cotton waste, then took another handful himself and neatly dabbed up a globule of the slimy filth that floated about the compartment. "Be sure your sick-kit is on tight. When you get sick, just stop and wait until it's over." Libby imitated him as best as he could. In a few minutes the room was free of the worst of the sickening debris. McCoy looked it over, and spoke:

"Now peel off them dirty duds, and change your kits. Three or four of you bring everything along to the starboard lock."

At the starboard spacelock, the kits were put in first, the inner door closed, and the outer opened. When the inner door was opened again the kits were gone-blown out into space by the escaping air. Pinkie addressed McCoy,

"Do we have to throw away our dirty clothes too?"

"Huh uh, we'll just give them a dose of vacuum. Take 'em into the lock and stop 'em to those hooks on the bulkheads. Tie 'em tight."

This time the lock was left closed for about five minutes. When the lock was opened the garments were bone dry—all the moisture boiled out by the vacuum of space. All that remained of the unpleasant rejecta was a sterile powdery residue. McCoy viewed them with approval. "They'll do. Take them back to the compartment. Then brush them—hard—in front of the exhaust blowers."

The next few days were an eternity of misery. Homesickness was forgotten in the all-engrossing wretchedness of spacesickness. The Captain granted fifteen minutes of mild acceleration for each of the nine meal periods, but the respite accentuated the agony. Libby would go to a meal, weak and ravenously hungry. The meal would stay down until free flight was resumed, then the sickness would hit him all over again.

On the fourth day he was seated against a bulkhead, enjoying the luxury of a few remaining minutes of weight while the last shift ate, when McCoy walked in and sat down beside him. The gunner's mate fitted a smoke filter over his face and lit a cigarette. He inhaled deeply and started to chat.

"How's it going, bud?"

"All right, I guess. This spacesickness— Say, McCoy, how do you ever get used to it?"

"You get over it in time. Your body acquires new reflexes, so they tell me. Once you learn to swallow without choking, you'll be all right. You even get so you like it. It's restful and relaxing. Four hours sleep is as good as ten."

Libby shook his head dolefully. "I don't think I'll ever get used to it."

'Yes, you will. You'd better anyway. This here asteroid won't have any surface gravity to speak of; the Chief Quartermaster says it won't

run over two per cent Earth normal. That ain't enough to cure spacesickness. And there won't be any way to accelerate for meals either."

Libby shivered and held his head between his hands.

Locating one asteroid among a couple of thousand is not as easy as finding Trafalgar Square in London—especially against the star-crowded backdrop of the galaxy. You take off from Terra with its orbital speed of about nineteen miles per second. You attempt to settle into a composite conoid curve that will not only intersect the orbit of the tiny fast-moving body, but also accomplish an exact rendezvous. Asteroid HS-5388, 'Eighty-eight,' lay about two and two-tenths astronomical units out from the sun, a little more than two hundred million miles; when the transport took off it lay beyond the sun better than three hundred million miles. Captain Doyle instructed the navigator to plot the basic ellipsoid to tack in free flight around the sun through an elapsed distance of some three hundred and forty million miles. The principle involved is the same as used by a hunter to wing a duck in flight by 'leading' the bird in flight. But suppose that you face directly into the sun as you shoot; suppose the bird can not be seen from where you stand, and you have nothing to aim by but some old reports as to how it was flying when last seen?

On the ninth day of the passage Captain Doyle betook himself to the chart room and commenced punching keys on the ponderous integral calculator. Then he sent his orderly to present his compliments to the navigator and to ask him to come to the chartroom. A few minutes later a tall heavyset form swam through the door, steadied himself with a grabline and greeted the captain.

"Good morning, Skipper."

"Hello, Blackie." The Old Man looked up from where he was strapped into the integrator's saddle. "I've been checking your corrections for the meal time accelerations."

"It's a nuisance to have a bunch of ground-lubbers on board, sir."

"Yes, it is, but we have to give those boys a chance to eat, or they couldn't work when we got there. Now I want to decelerate starting about ten o'clock, ship's time. What's our eight o'clock speed and co-ordinates?"

The Navigator slipped a notebook out of his tunic. "Three hundred fifty-eight miles per second; course is right ascension fifteen hours, eight minutes, twenty-seven seconds, declination minus seven degrees, three minutes; solar distance one hundred and ninety-two million four hundred eighty thousand miles. Our radial position is twelve degrees above course, and almost dead on course in R.A. Do you want Sol's co-ordinates?"

"No, not now." The captain bent over the calculator, frowned and

chewed the tip of his tongue as he worked the controls. “I want you to kill the acceleration about one million miles inside Eighty-eight’s orbit. I hate to waste the fuel, but the belt is full of junk and this damned rock is so small that we will probably have to run a search curve. Use twenty hours on deceleration and commence changing course to port after eight hours. Use normal asymptotic approach. You should have her in a circular trajectory abreast of Eighty-eight, and paralleling her orbit by six o’clock tomorrow morning. I shall want to be called at three.”

“Aye aye, sir.”

“Let me see your figures when you get ‘em. I’ll send up the order book later.”

The transport accelerated on schedule. Shortly after three the Captain entered the control room and blinked his eyes at the darkness. The sun was still concealed by the hull of the transport and the midnight blackness was broken only by the dim blue glow of the instrument dials, and the crack of light from under the chart hood. The Navigator turned at the familiar tread.

“Good morning, Captain.”

“Morning, Blackie. In sight yet?”

“Not yet. We’ve picked out half a dozen rocks, but none of them checked.”

“Any of them close?”

“Not uncomfortably. We’ve overtaken a little sand from time to time.”

“That can’t hurt us—not on a stern chase like this. If pilots would only realize that the asteroids flow in fixed directions at computable speeds nobody would come to grief out here.” He stopped to light a cigarette. “People talk about space being dangerous. Sure, it used to be; but I don’t know of a case in the past twenty years that couldn’t be charged up to some fool’s recklessness.”

“You’re right, Skipper. By the way, there’s coffee under the chart hood.”

“Thanks; I had a cup down below.” He walked over by the lookouts at stereoscopes and radar tanks and peered up at the star-flecked blackness. Three cigarettes later the lookout nearest him called out.

“Light hoi”

“Where away?”

His mate read the exterior dials of the stereoscope. “Plus point two, abaft one point three, slight drift astern.” He shifted to radar and added, “Range seven nine oh four three.”

“Does that check?”

“Could be, Captain. What is her disk?” came the Navigator’s

muffled voice from under the hood. The first lookout hurriedly twisted the knobs of his instrument, but the Captain nudged him aside.

"I'll do this, son." He fitted his face to the double eye guards and surveyed a little silvery sphere, a tiny moon. Carefully he brought two illuminated cross-hairs up until they were exactly tangent to the upper and lower limbs of the disk. "Mark!"

The reading was noted and passed to the Navigator, who shortly ducked out from under the hood.

"That's our baby, Captain."

"Good."

"Shall I make a visual triangulation?"

"Let the watch officer do that. You go down and get some sleep. I'll ease her over until we get close enough to use the optical range finder."

"Thanks, I will."

Within a few minutes the word had spread around the ship that Eighty-eight had been sighted. Libby crowded into the starboard troop deck with a throng of excited mess mates and attempted to make out their future home from the view port. McCoy poured cold water on their excitement.

"By the time that rock shows up big enough to tell anything about it with your naked eye we'll all be at our grounding stations. She's only about a hundred miles thick, yuh know."

And so it was. Many hours later the ship's announcer shouted:

"All hands! Man your grounding stations. Close all air-tight doors. Stand by to cut blowers on signal."

McCoy forced them to lie down throughout the ensuing two hours. Short shocks of rocket blasts alternated with nauseating weightlessness. Then the blowers stopped and check valves clicked into their seats. The ship dropped free for a few moments—a final quick blast—five seconds of falling, and a short, light, grinding bump. A single bugle note came over the announcer, and the blowers took up their hum.

McCoy floated lightly to his feet and poised, swaying, on his toes. "All out, troops—this is the end of the line."

A short chunky lad, a little younger than most of them, awkwardly emulated him, and bounded toward the door, shouting as he went, "Come on, fellows! Let's go outside and explore!"

The Master-at-Arms squelched him. "Not so fast, kid. Aside from the fact that there is no air out there, go right ahead. You'll freeze to death, burn to death, and explode like a ripe tomato. Squad leader, detail six men to break out spacesuits. The rest of you stay here and stand by."

The working party returned shortly loaded down with a couple of

dozen bulky packages. Libby let go the four he carried and watched them float gently to the deck. McCoy unzipped the envelope from one suit, and lectured them about it.

"This is a standard service type, general issue, Mark IV, Modification 2." He grasped the suit by the shoulders and shook it out so that it hung like a suit of long winter underwear with the helmet lolling helplessly between the shoulders of the garment. "It's self-sustaining for eight hours, having an oxygen supply for that period. It also has a nitrogen trim tank and a carbon-dioxide-water-vapor cartridge filter."

He droned on, repeating practically verbatim the description and instructions given in training regulations. McCoy knew these suits like his tongue knew the roof of his mouth; the knowledge had meant his life on more than one occasion.

"The suit is woven from glass fibre laminated with non-volatile asbesto-cellutite. The resulting fabric is flexible, very durable; and will turn all rays normal to solar space outside the orbit of Mercury. It is worn over your regular clothing, but notice the wire-braced accordion pleats at the major joints. They are so designed as to keep the internal volume of the suit nearly constant when the arms or legs are bent. Otherwise the gas pressure inside would tend to keep the suit blown up in an erect position, and movement while wearing the suit would be very fatiguing.

"The helmet is moulded from a transparent silicone, leaded and polarized against too great ray penetration. It may be equipped with external visors of any needed type. Orders are to wear not less than a number-two amber on this body. In addition, a lead plate covers the cranium and extends on down the back of the suit, completely covering the spinal column.

"The suit is equipped with two-way telephony. If your radio quits, as these have a habit of doing, you can talk by putting your helmets in contact. Any questions?"

"How do you eat and drink during the eight hours?"

"You don't stay in 'em any eight hours. You can carry sugar balls in a gadget in the helmet, but you boys will always eat at the base. As for water, there's a nipple in the helmet near your mouth which you can reach by turning your head to the left. It's hooked to a built-in canteen. But don't drink any more water when you're wearing a suit than you have to. These suits ain't got any plumbing."

Suits were passed out to each lad, and McCoy illustrated how to don one. A suit was spread supine on the deck, the front zipper that stretched from neck to crotch was spread wide and one sat down inside this opening, whereupon the lower part was drawn on like long stockings. Then a wiggle into each sleeve and the heavy flexible

gauntlets were smoothed and patted into place. Finally an awkward backward stretch of the neck with shoulders hunched enabled the helmet to be placed over the head.

Libby followed the motions of McCoy and stood up in his suit. He examined the zipper which controlled the suit's only opening. It was backed by two soft gaskets which would be pressed together by the zipper and sealed by internal air pressure. Inside the helmet a composition mouthpiece for exhalation led to the filter.

McCoy bustled around, inspecting them, tightening a belt here and there, instructing them in the use of the external controls. Satisfied, he reported to the conning room that his section had received basic instruction and was ready to disembark. Permission was received to take them out for thirty minutes acclimatization.

Six at a time, he escorted them through the air lock, and out on the surface of the planetoid. Libby blinked his eyes at the unaccustomed luster of sunshine on rock. Although the sun lay more than two hundred million miles away and bathed the little planet with radiation only one fifth as strong as that lavished on mother Earth, nevertheless the lack of atmosphere resulted in a glare that made him squint. He was glad to have the protection of his amber visor. Overhead the sun, shrunk to penny size, shone down from a dead black sky in which unwinking stars crowded each other and the very sun itself.

The voice of a mess mate sounded in Libby's earphones, "Jeepers! That horizon looks close. I'll bet it ain't more'n a mile away."

Libby looked out over the flat bare plain and subconsciously considered the matter. "It's less," he commented, "than a third of a mile away."

"What the hell do you know about it, Pinkie? And who asked you, anyhow?"

Libby answered defensively, "As a matter of fact, it's one thousand six hundred and seventy feet, figuring that my eyes are five feet three inches above ground level."

"Nuts. Pinkie, you are always trying to show off how much you think you know."

"Why, I am not," Libby protested. "If this body is a hundred miles thick and as round as it looks: why, naturally the horizon *has* to be just that far away."

"Says *who*?"

McCoy interrupted.

"Pipe down! Libby is a lot nearer right than you were."

"He is exactly right," put in a strange voice. "I had to look it up for the navigator before I left control."

"Is that so?"—McCoy's voice again—"If the Chief Quartermaster

says you're right, Libby, you're right. How did you know?"

Libby flushed miserably. "I—I don't know. That's the only way it could be."

The gunner's mate and the quartermaster stared at him but dropped the subject.

By the end of the 'day' (ship's time, for Eighty-eight had a period of eight hours and thirteen minutes), work was well under way. The transport had grounded close by a low range of hills. The Captain selected a little bowl-shaped depression in the hills, some thousand feet long and half as broad, in which to establish a permanent camp. This was to be roofed over, sealed, and an atmosphere provided.

In the hill between the ship and the valley, quarters were to be excavated; dormitories, mess hall, officers' quarters, sick bay, recreation room, offices, store rooms, and so forth. A tunnel must be bored through the hill, connecting the sites of these rooms, and connecting with a ten foot airtight metal tube sealed to the ship's portside air-lock. Both the tube and tunnel were to be equipped with a continuous conveyor belt for passengers and freight.

Libby found himself assigned to the roofing detail. He helped a metal-smith struggle over the hill with a portable atomic heater, difficult to handle because of a mass of eight hundred pounds, but weighing here only sixteen pounds. The rest of the roofing detail were breaking out and preparing to move by hand the enormous translucent tent which was to be the 'sky' of the little valley.

The metalsmith located a landmark on the inner slope of the valley, set up his heater, and commenced cutting a deep horizontal groove or step in the rock. He kept it always at the same level by following a chalk mark drawn along the rock wall. Libby enquired how the job had been surveyed so quickly.

"Easy," he was answered, "two of the quartermasters went ahead with a transit, leveled it just fifty feet above the valley floor, and clamped a searchlight to it. Then one of 'em ran like hell around the rim, making chalk marks at the height at which the beam struck."

"Is this roof going to be just fifty feet high?"

"No, it will average maybe a hundred. It bellies up in the middle from the air pressure."

"Earth normal?"

"Half Earth normal."

Libby concentrated for an instant, then looked puzzled. "But look — This valley is a thousand feet long and better than five hundred wide. At half of fifteen pounds per square inch, and allowing for the arch of the roof, that's a load of one and an eighth billion pounds. What fabric can take that kind of a load?"

"Cobwebs."

"Cobwebs?"

"Yeah, cobwebs. Strongest stuff in the world, stronger than the best steel. Synthetic spider silk. This gauge we're using for the roof has a tensile strength of four thousand pounds a running inch."

Libby hesitated a second, then replied, "I see. With a rim about eighteen hundred thousand inches around, the maximum pull at the point of anchoring would be about six hundred and twenty-five pounds per inch. Plenty safe margin."

The metalsmith leaned on his tool and nodded. "Something like that. You're pretty quick at arithmetic, aren't you, bud?"

Libby looked startled. "I just like to get things straight."

They worked rapidly around the slope, cutting a clean smooth groove to which the 'cobweb' could be anchored and sealed. The white-hot lava spewed out of the discharge vent and ran slowly down the hillside. A brown vapor boiled off the surface of the molten rock, arose a few feet and sublimed almost at once in the vacuum to white powder which settled to the ground. The metalsmith pointed to the powder.

"That stuff 'ud cause silicosis if we let it stay there, and breathed it later."

"What do you do about it?"

"Just clean it out with the blowers of the air conditioning plant."

Libby took this opening to ask another question. "Mister—?"

"Johnson's my name. No mister necessary."

"Well, Johnson, where do we get the air for this whole valley, not to mention the tunnels? I figure we must need twenty-five million cubic feet or more. Do we manufacture it?"

"Naw, that's too much trouble. We brought it with us."

"On the transport?"

"Uh huh, at fifty atmospheres."

Libby considered this. "I see—that way it would go into a space eighty feet on a side."

"Matter of fact it's in three specially constructed holds—giant air bottles. This transport carried air to Ganymede. I was in her then—a recruit, but in the air gang even then."

In three weeks the permanent camp was ready for occupancy and the transport cleared of its cargo. The storerooms bulged with tools and supplies. Captain Doyle had moved his administrative offices underground, signed over his command to his first officer, and given him permission to proceed on 'duty assigned'—in this case; return to Terra with a skeleton crew.

Libby watched them take off from a vantage point on the hillside. An overpowering homesickness took possession of him. Would he ever go home? He honestly believed at the time that he would swap the

rest of his life for thirty minutes each with his mother and with Betty.

He started down the hill toward the tunnel lock. At least the transport carried letters to them, and with any luck the chaplain would be by soon with letters from Earth. But tomorrow and the days after that would be no fun. He had enjoyed being in the air gang, but tomorrow he went back to his squad. He did not relish that-the boys in his squad were all right, he guessed, but he just could not seem to fit in.

This company of the C.C.C. started on its bigger job; to pock-mark Eighty-eight with rocket tubes so that Captain Doyle could push this hundred-mile marble out of her orbit and herd her in to a new orbit between Earth and Mars, to be used as a space station—a refuge for ships in distress, a haven for life boats, a fueling stop, a naval outpost.

Libby was assigned to a heater in pit H-16. It was his business to carve out carefully calculated emplacements in which the blasting crew then set off the minute charges which accomplished the major part of the excavating. Two squads were assigned to H-16, under the general supervision of an elderly marine gunner. The gunner sat on the edge of the pit, handling the plans, and occasionally making calculations on a circular slide rule which hung from a lanyard around his neck.

Libby had just completed a tricky piece of cutting for a three-stage blast, and was waiting for the blasters, when his phones picked up the gunner's instructions concerning the size of the charge. He pressed his transmitter button.

"Mr. Larsen! You've made a mistake!"

"Who said that?"

"This is Libby. You've made a mistake in the charge. If you set off that charge, you'll blow this pit right out of the ground, and us with it."

Marine Gunner Larsen spun the dials on his slide rule before replying, "You're all het up over nothing, son. That charge is correct."

"No, I'm not, sir," Libby persisted, "you've multiplied where you should have divided."

"Have you had any experience at this sort of work?"

"No, sir."

Larsen addressed his next remark to the blasters. "Set the charge."

They started to comply. Libby gulped, and wiped his lips with his tongue. He knew what he had to do, but he was afraid. Two clumsy stiff-legged jumps placed him beside the blasters. He pushed between them and tore the electrodes from the detonator. A shadow passed over him as he worked, and Larsen floated down beside him. A hand grasped his arm.

"You shouldn't have done that, son. That's direct disobedience of

orders. I'll have to report you." He commenced reconnecting the firing circuit.

Libby's ears burned with embarrassment, but he answered back with the courage of timidity at bay. "I had to do it, sir. You're still wrong."

Larsen paused and ran his eyes over the dogged face. "Well—it's a waste of time, but I don't like to make you stand by a charge you're afraid of. Let's go over the calculation together."

Captain Doyle sat at his ease in his quarters, his feet on his desk. He stared at a nearly empty glass tumbler.

"That's good beer, Blackie. Do you suppose we could brew some more when it's gone?"

"I don't know, Cap'n. Did we bring any yeast?"

"Find out, will you?" He turned to a massive man who occupied the third chair. "Well, Larsen, I'm glad it wasn't any worse than it was."

"What beats me, Captain, is how I could have made such a mistake. I worked it through twice. If it had been a nitro explosive, I'd have known off hand that I was wrong. If this kid hadn't had a hunch, I'd have set it off."

Captain Doyle clapped the old warrant officer on the shoulder. "Forget it, Larsen. You wouldn't have hurt anybody; that's why I require the pits to be evacuated even for small charges. These isotope explosives are tricky at best. Look what happened in pit A-9. Ten days' work shot with one charge, and the gunnery officer himself approved that one. But I want to see this boy. What did you say his name was?"

"Libby, A. J."

Doyle touched a button on his desk. A knock sounded at the door. A bellowed "Come in!" produced a stripling wearing the brassard of Corps-man Mate-of-the-Deck.

"Have Corpsman Libby report to me."

"Aye aye, sir."

Some few minutes later Libby was ushered into the Captain's cabin. He looked nervously around, and noted Larsen's presence, a fact that did not contribute to his peace of mind. He reported in a barely audible voice, "Corpsman Libby, sir."

The Captain looked him over. "Well, Libby, I hear that you and Mr. Larsen had a difference of opinion this morning. Tell me about it."

"I—I didn't mean any harm, sir."

"Of course not. You're not in any trouble; you did us all a good turn this morning. Tell me, how did you know that the calculation was wrong? Had any mining experience?"

"No, sir. I just saw that he had worked it out wrong."

"But how?"

Libby shuffled uneasily. “Well, sir, it just seemed wrong—It didn’t fit.”

“Just a second, Captain. May I ask this young man a couple of questions?” It was Commander “Blackie” Rhodes who spoke.

“Certainly. Go ahead.”

“Are you the lad they call ‘Pinkie’?”

Libby blushed. “Yes, sir.”

“I’ve heard some rumors about this boy.” Rhodes pushed his big frame out of his chair, went over to a bookshelf, and removed a thick volume. He thumbed through it, then with open book before him, started to question Libby.

“What’s the square root of ninety-five?”

“Nine and seven hundred forty-seven thousandths.”

“What’s the cube root?”

“Four and five hundred sixty-three thousandths.”

“What’s its logarithm?”

“Its what, sir?”

“Good Lord, can a boy get through school today without knowing?”

The boy’s discomfort became more intense. “I didn’t get much schooling, sir. My folks didn’t accept the Covenant until Pappy died, and we had to.”

“I see. A logarithm is a name for a power to which you raise a given number, called the base, to get the number whose logarithm it is. Is that clear?”

Libby thought hard. “I don’t quite get it, sir.”

“I’ll try again. If you raise ten to the second power—square it—it gives one hundred. Therefore the logarithm of a hundred to the base ten is two. In the same fashion the logarithm of a thousand to the base ten is three. Now what is the logarithm of ninety-five?”

Libby puzzled for a moment. “I can’t make it come out even. It’s a fraction.”

“That’s okay.”

“Then it’s one and nine hundred seventy-eight thousandths—just about.”

Rhodes turned to the Captain. “I guess that about proves it, sir.”

Doyle nodded thoughtfully. “Yes, the lad seems to have intuitive knowledge of arithmetical relationships. But let’s see what else he has.”

“I am afraid we’ll have to send him back to Earth to find out properly.”

Libby caught the gist of this last remark. “Please, sir, you aren’t going to send me home? Maw ‘ud be awful vexed with me.”

“No, no, nothing of the sort. When your time is up, I want you to

be checked over in the psychometrical laboratories. In the meantime I wouldn't part with you for a quarter's pay. I'd give up smoking first. But let's see what else you can do."

In the ensuing hour the Captain and the Navigator heard Libby: one, deduce the Pythagorean proposition; two, derive Newton's laws of motion and Kepler's laws of ballistics from a statement of the conditions in which they obtained; three, judge length, area, and volume by eye with no measurable error. He had jumped into the idea of relativity and non-rectilinear space-time coritinua, and was beginning to pour forth ideas faster than he could talk, when Doyle held up a hand.

"That's enough, son. You'll be getting a fever. You run along to bed now, and come see me in the morning. I'm taking you off field work."

"Yes, sir."

"By the way, what is your full name?"

"Andrew Jackson Libby, sir."

"No, your folks wouldn't have signed the Covenant. Good night."

"Good night, sir."

After he had gone, the two older men discussed their discovery.

"How do you size it up, Captain?"

"Well, he's a genius, of course—one of those wild talents that will show up once in a blue moon. I'll turn him loose among my books and see how he shapes up. Shouldn't wonder if he were a page-at-a-glance reader, too."

"It beats me what we turn up among these boys—and not a one of 'em any account back on Earth."

Doyle nodded. "That was the trouble with these kids. They didn't feel needed."

Eighty-eight swung some millions of miles further around the sun. The pock-marks on her face grew deeper, and were lined with durite, that strange close-packed laboratory product which (usually) would confine even atomic disintegration. Then Eighty-eight received a series of gentle pats, always on the side headed along her course. In a few weeks' time the rocket blasts had their effect and Eighty-eight was plunging in an orbit toward the sun.

When she reached her station one and three-tenths the distance from the sun of Earth's orbit, she would have to be coaxed by another series of pats into a circular orbit. Thereafter she was to be known as E-M3, Earth-Mars Space Station Spot Three.

Hundreds of millions of miles away two other C.C.C. companies were inducing two other planetoids to quit their age-old grooves and slide between Earth and Mars to land in the same orbit as Eighty-eight. One was due to ride this orbit one hundred and twenty degrees

ahead of Eighty-eight, the other one hundred and twenty degrees behind. When E-Mi, E-M2, and E-M3 were all on station no hard-pushed traveler of the space-ways on the Earth-Mars passage would ever again find himself far from land—or rescue.

During the months that Eighty-eight fell free toward the sun, Captain Doyle reduced the working hours of his crew and turned them to the comparatively light labor of building a hotel and converting the little roofed-in valley into a garden spot. The rock was broken down into soil, fertilizers applied, and cultures of anaerobic bacteria planted. Then plants, conditioned by thirty-odd generations of low gravity at Luna City, were set out and tenderly cared for. Except for the low gravity, Eighty-eight began to feel like home.

But when Eighty-eight approached a tangent to the hypothetical future orbit of E-M3, the company went back to maneuvering routine, watch on and watch off, with the Captain living on black coffee and catching catnaps in the plotting room.

Libby was assigned to the ballistic calculator, three tons of thinking metal that dominated the plotting room. He loved the big machine. The Chief Fire Controlman let him help adjust it and care for it. Libby subconsciously thought of it as a person—his own kind of person.

On the last day of the approach, the shocks were more frequent. Libby sat in the right-hand saddle of the calculator and droned out the predic-tions for the next salvo, while gloating over the accuracy with which the machine tracked. Captain Doyle fussed around nervously, occasionally stopping to peer over the Navigator's shoulder. Of course the figures were right, but what if it didn't work? No one had ever moved so large a mass before. Suppose it plunged on and on—and on. Nonsense! It couldn't. Still he would be glad when they were past the critical speed.

A marine orderly touched his elbow. "Helio from the Flagship, sir."

"Read it."

"Flag to Eighty-eight; private message, Captain Doyle; am lying off to watch you bring her in.—Kearney."

Doyle smiled. Nice of the old geezer. Once they were on station, he would invite the Admiral to ground for dinner and show him the park.

Another salvo cut loose, heavier than any before. The room trembled violently. In a moment the reports of the surface observers commenced to trickle in. "Tube nine, clear!"

"Tube ten, clear!"

But Libby's drone ceased.

Captain Doyle turned on him. "What's the matter, Libby? Asleep?

Call the polar stations. I have to have a parallax."

"Captain—" The boy's voice was low and shaking.

"Speak up, man!"

"Captain—the machine isn't tracking."

"Spiers!" The grizzled head of the Chief Fire Controlman appeared from behind the calculator.

"I'm already on it, sir. Let you know in a moment."

He ducked back again. After a couple of long minutes he reappeared. "Gyros tumbled. It's a twelve hour calibration job, at least."

The Captain said nothing, but turned away, and walked to the far end of the room. The Navigator followed him with his eyes. He returned, glanced at the chronometer, and spoke to the Navigator.

"Well, Blackie, if I don't have that firing data in seven minutes, we're sunk. Any suggestions?"

Rhodes shook his head without speaking.

Libby timidly raised his voice. "Captain—"

Doyle jerked around. "Yes?"

"The firing data is tube thirteen, seven point six three; tube twelve, six point nine oh; tube fourteen, six point eight nine."

Doyle studied his face. "You sure about that, son?"

"It *has* to be that, Captain."

Doyle stood perfectly still. This time he did not look at Rhodes but stared straight ahead. Then he took a long pull on his cigarette, glanced at the ash, and said in a steady voice,

"Apply the data. Fire on the bell."

Four hours later, Libby was still droning out firing data, his face grey, his eyes closed. Once he had fainted but when they revived him he was still muttering figures. From time to time the Captain and the Navigator relieved each other, but there was no relief for him.

The salvos grew closer together, but the shocks were lighter.

Following one faint salvo, Libby looked up, stared at the ceiling, and spoke.

"That's all, Captain."

"Call polar stations!"

The reports came back promptly, "Parallax constant, sidereal-solar rate constant."

The Captain relaxed into a chair. "Well, Blackie, we did it—thanks to Libby!" Then he noticed a worried, thoughtful look spread over Libby's face. "What's the matter, man? Have we slipped up?"

"Captain, you know you said the other day that you wished you had Earth-normal gravity in the park?"

"Yes. What of it?"

"If that book on gravitation you lent me is straight dope, I think I

know a way to accomplish it."

The Captain inspected him as if seeing him for the first time. "Libby, you have ceased to amaze me. Could you stop doing that sort of thing long enough to dine with the Admiral?"

"Gee, Captain, that would be swell!"

The audio circuit from Communications cut in.

"Helio from Flagship: 'Well done, Eighty-eight.'"

Doyle smiled around at them all. "That's pleasant confirmation."

The audio brayed again.

"Helio from Flagship: 'Cancel last signal, stand by for correction.'"

A look of surprise and worry sprang into Doyle's face—then the audio continued:

"Helio from Flagship: 'Well done, E-M3.'"